Expert-Based Development of a Site-specific Standard in CO_2 Sequestration Monitoring Technology - EPA

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Project Goals

- Develop guidance for monitoring approaches for a CO_2 sequestration site
  - Site and risk specific
  - Based on quantification of monitoring tool sensitivity
- Expert Panel
  - Data based input
  - Develop wide consensus
- Useful end Product
  - case-based training workbook
- More than a list of tools; dynamic approach

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Project Status

- First meeting of Expert Panel - May 5, Natchez, Mississippi
  - Pre-meeting for IEA GHG R&D Programme Monitoring Network and field trip to Cranfield

Historic Natchez

Cranfield Site visit

Expert panelists

- Researchers with specialty in one or more modeling techniques and field data:
  - RCSP
    - 7 partnerships
    - Work with other projects?
  - Otway
  - Nagaoka
  - EOR
  - Weyburn
  - Gorgon, In Salah, Ketzin, Sleipner

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Tool sets to be assessed

- Hydrological
- Geochemical
- Geomechanical
- Geophysical
- Focus on commonly used and accepted tools

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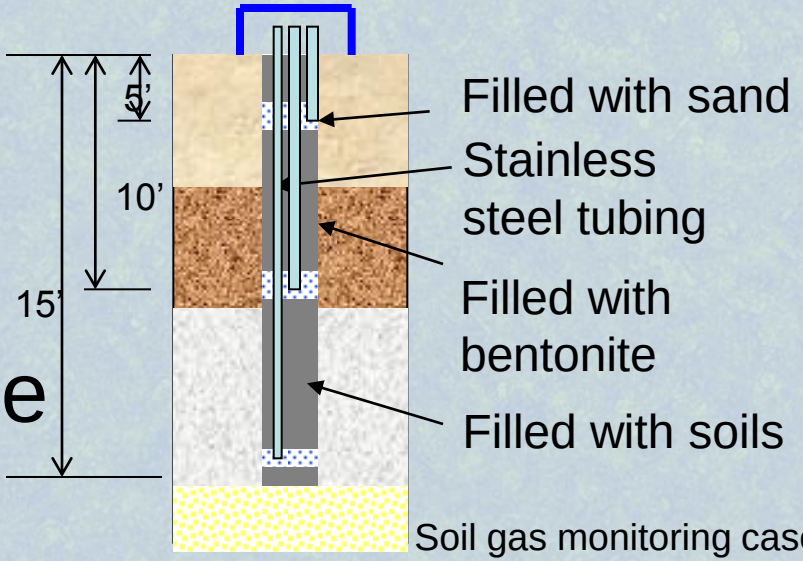
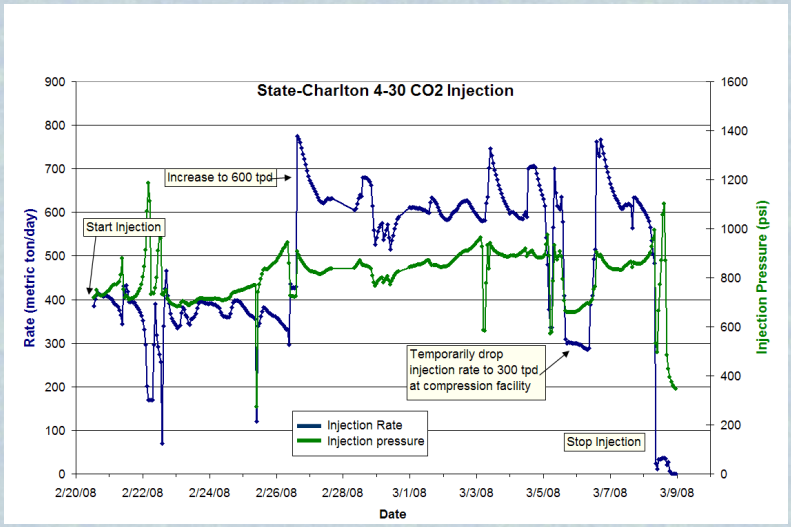
Tool sets to be assessed (1)

- Near surface
  - Atmosphere - tracers
  - Soil – tracers
  - USDW – chemistry and tracers
- Pressure and Temperature
  - Wellhead & bottom hole
  - Continuous/intermittent



Soil gas monitoring case from **Cranfield, MS**



Continuous pressure monitoring case from **MRCSP Michigan** project

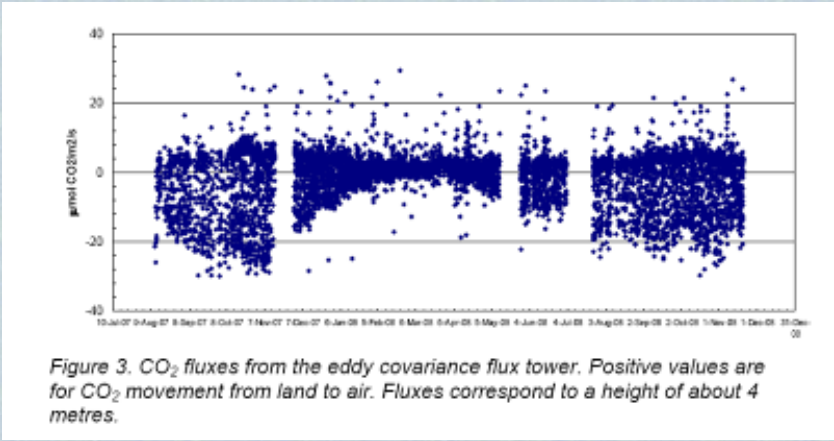


Figure 3. CO_2 fluxes from the eddy covariance flux tower. Positive values are for CO_2 movement from land to air. Fluxes correspond to a height of about 4 metres.

Natural and seasonal and daily CO_2 flux at **Otway, Australia**

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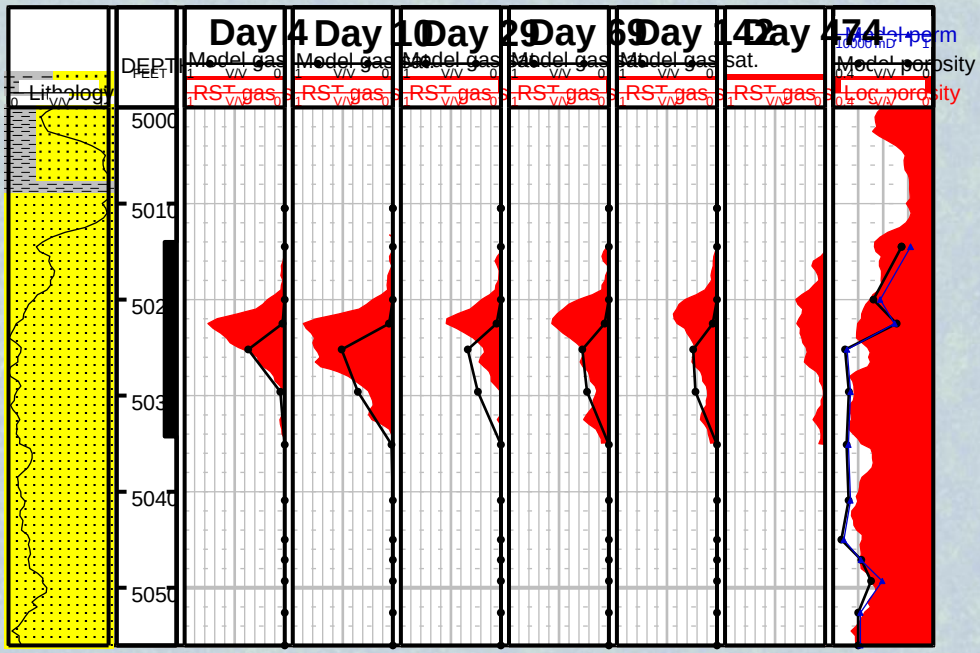
Tool sets to be assessed (2)

- Wireline data

Frio, TX test
log measurement of change in saturation



- Gravity
  - recent deployments – analyze sensitivity
    - Cranfield, Sleipner

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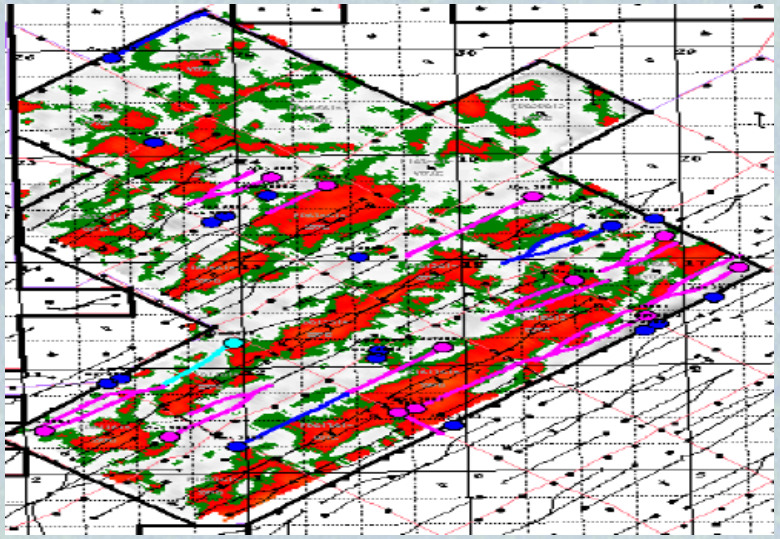
Tool sets to be assessed (3)

- **Produced fluids and tracers**
  - **EOR type monitoring of production**
  - **Tracer studies**
- **Seismic**
  - **2D surface**
  - **3D surface**
  - **Borehole**
  - **Microseismic**



Weyburn time-lapse seismic
Malcolm Wilson, 2005

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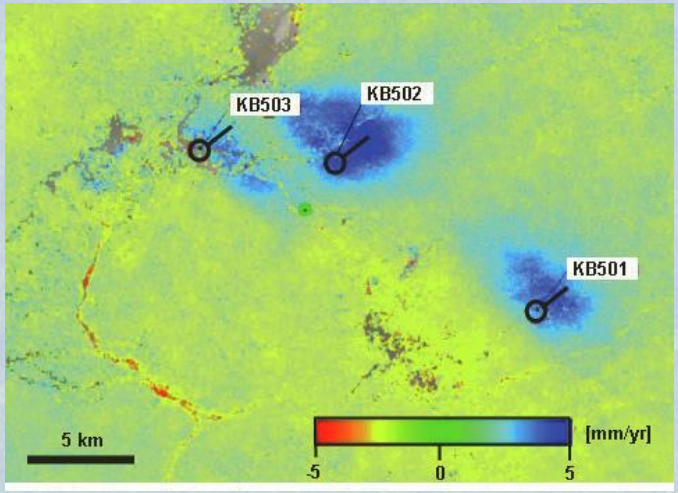
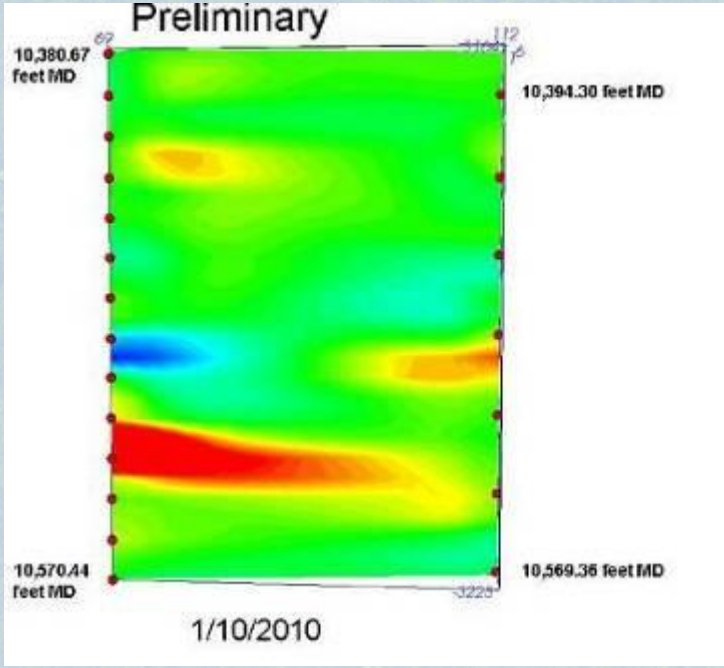
Tool sets to be assessed (4)

- Electrical properties
  - Electrical resistance tomography (ERT)
    - Recent downhole success at Ketzin and Cranfield
    - Other electrical tools
- Geomechanics – InSAR
  - Recent success at In Salah



Rutqist, Vasco, Meyer, 2009
In Salah, Algeria



Charles Carrigan, LLNL
Cranfield, MS

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Cooperation with CCP-3

- Broaden and deepen assessment of tool sets
- Increased international expertise
  - Information exchange with monitoring project now being conducted by British Geological Survey for ETI
  - Data from international projects to increase sample size

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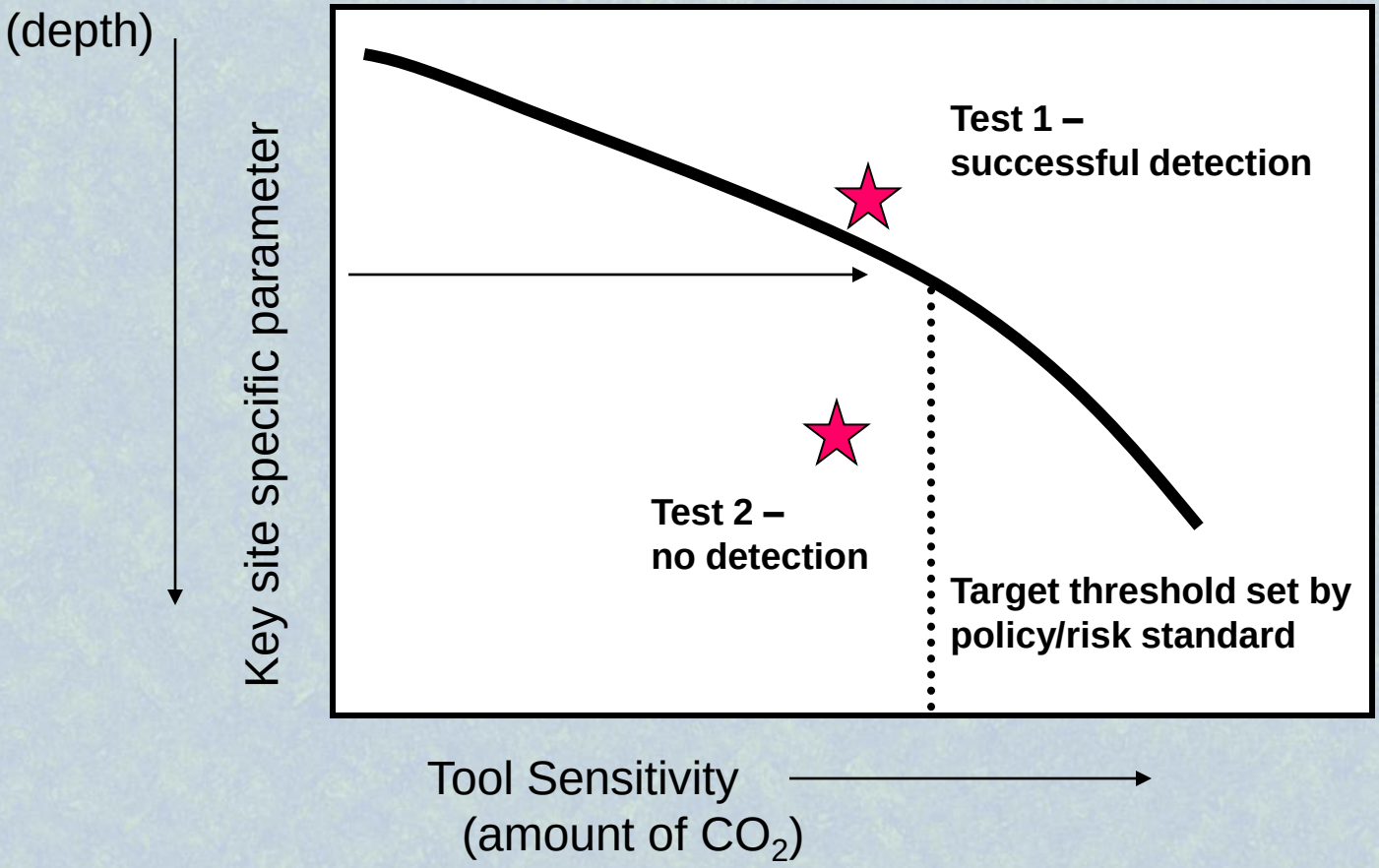
Nomogram Concept



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Examples of Site-Specific Parameters

- Depth to injection/leakage zone
- Depth of USDW
- Salinity injection/leakage zone
- Plume thickness injection/leakage zone
- Background variability in parameter of interest
- Contrast with dense/gas phase/dissolved CO_2
- Heterogeneity / depositional environment
- Lithology (carbonates, clastics)
- …..

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Examples of Cases Unfavorable for Detection

- SACROC – direct detection of dissolved CO_2 in USDW – natural CO_2 content too variable
- Nagaoka - Surface seismic not clear detection of CO_2 – need expert assessment of reason for non-detection

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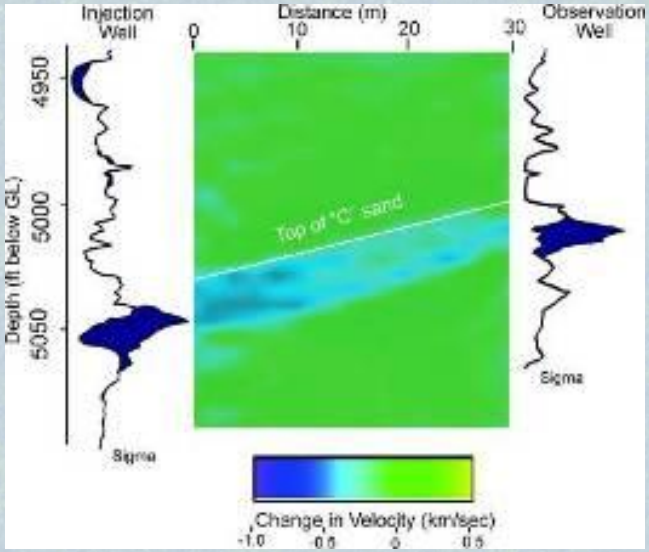
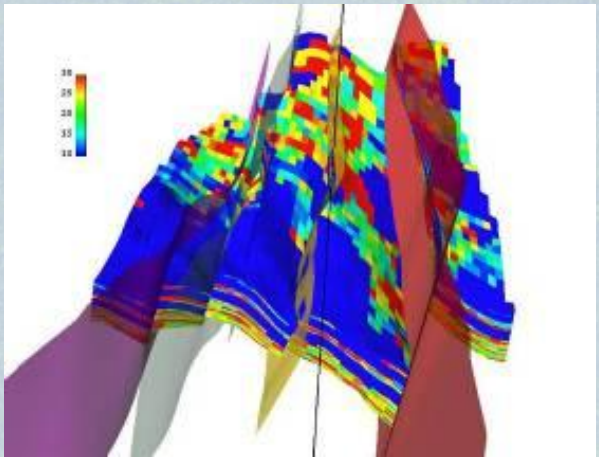
Role of Models in Developing Test Cases –and Workbook

Surface settings
and monitoring plan



Frio, TX: Artificial but realistic leak provided via modeling match to field tests



Detailed reservoir model – but no known leakage

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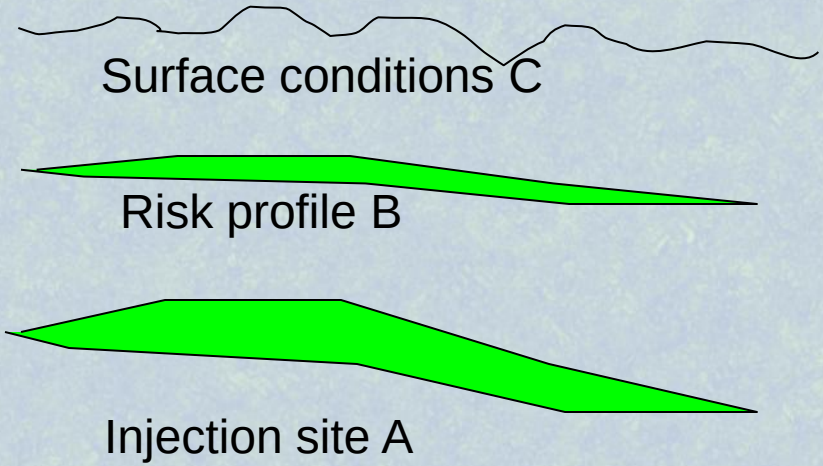
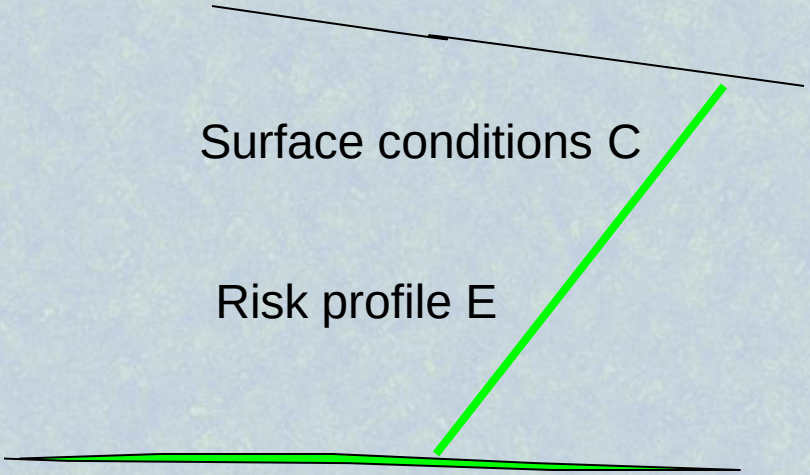
Matching Tools to Sites –Training Workbook



Successful documentation that risk B is not occurring though MVA strategy 1



Injection site D

Successful documentation that risk E is not occurring though MVA strategy 2

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Thanks

- Welcome comments and input
- Look forward to additional collaborations
- Especially welcome site specific data and model that could be used a realistic cases

- www.gulfcoastcarbon.org

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